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are strain and relaxation, imagined movements, auditory rhythm and the spontaneous occurrence of auditory images of the limiting stimulus.

(2) Where strain and relaxation were prominently concerned there was a tendency to shorten the longer standards, possibly on account of fatigue.

(3) Where a short and a long standard were alternately used no contrast effect whatever was visible; rather there were some indications of a tendency to assimilate the two towards an intermediate value.

IV. THE LOSS OF ASSOCIATIVE POWER IN WORDS AFTER LONG FIXATION.

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The phenomenon referred to in the title of this paper is one that is familiar to most people, but has never, so far as we are aware, been made the subject of experimental study. If a printed word is looked at steadily for some little time, it will be found to take on a curiously strange and foreign aspect. This loss of familiarity in its appearance sometimes makes it look like a word in another language, sometimes proceeds further until the word is a mere collection of letters, and occasionally reaches the extreme where the letters themselves look like meaningless marks on the paper. In the present study we have attempted to observe this process in detail and under experimental control.

To secure uniformity, the words used were all of six letters, printed in long primer type, cut out of the same periodical and placed upon a background of white paper. Words without capital letters were employed. The observers, six women, all with a fair amount of introspective training, were required to look fixedly at a word for a period of three minutes, measured by a stop watch, and to describe all the changes undergone by the appearance of the word. The approximate time of these changes was noticed. A few typical instances of the resultant phenomena are here given:

- (1) Word: *career*. Observer: W.
 Time: 6 sec. *reer* stands out prominently and gives the word an unfamiliar look.
 22 sec. Sound suggestion = *care—er*.
 32 sec. “ “ = *career*, for a single instant.
 46 sec. The second *e* looks like *c*; the sound of the Latin word *carcer* suggested.
 1 min. 20 sec. No sound suggestion: the word looks entirely foreign.

2 min. 48 sec. A mere collection of letters, with occasional 'flashes' of the 'career' sound.

(2) Word: *blood*.

Observer: S.

Time: 13 sec. Sound blood.

24 sec. " loo, b and d look like each other turned backwards, hence meaningless.

1 min. o's look unfamiliar, staring.

1 " 12 sec. b and d look like p and q upside down.

1 " 35 sec. Sound 'blood,' then 'blōōd,' then 'loo.'

2 " 59 sec. A collection of letters.

(3) Word: *rumble*.

Observer: Ald.

2 sec. Sound of thunder.

11 sec. " " bumble bee.

21 sec. Word divides into rum ble.

59 sec. umble. Uriah Heep.

1 min. 21 sec. No meaning to word.

29 sec. u looked like n upside down. No sound or meaning.

2 min. 29 sec. Think of sound, but it no longer fits the look of the word.

2 min. 59 sec. Letters all look queer.

These examples will serve to illustrate the general character of the results. The following fact appeared as the outcome of a careful comparison of the data from all the observers. If the components which enter into the mental complex ordinarily involved in the sight of a printed word be grouped under the three heads of visual, auditory-motor and meaning elements, it may be said that the meaning of the word and its normal auditory-motor image usually disappeared from consciousness within a few seconds after fixation began. The place of the normal auditory-motor image was often taken by others suggested by fragments of the visual word which assumed special prominence; in other cases foreign language sound associations appeared. At instants during the entire experiment the normal sound image might recur 'for a flash.' In the latter part of an experiment all sound and meaning elements would often vanish, yet the combination of visual elements would still be a familiar one. Later, the visual word might lose its familiarity as a combination and be described as "a collection of letters." And finally, even the letters themselves sometimes became unfamiliar, the printed word appearing to be a number of strange marks on the paper. These stages by no means all occurred in every experiment, but they were observed with sufficient frequency to allow their order to be approximately determined as above. In explanation of them the following considerations are offered.

The first effect of gazing fixedly at a word is naturally to concentrate attention upon its *appearance*. Under ordinary circumstances, the look of a word in a familiar language is attended to only for the briefest possible instant; its sound and meaning associations at once enter upon possession of the field

of attention. The very fact that the observer in our experiments was told to look fixedly at the word resulted in an abnormal prominence of the visual elements in the ordinary word complex. Several phenomena connected with this fact were observed which greatly contributed to the loss of the normal associations of the word. First, the letters in the word tended to fall into groups. The normal sound association of the whole word accordingly vanished, and each of the two or more groups of letters into which the word disintegrated gave a sound suggestion of its own. Thus 'castle' became 'cast-le,' 'toward' became 'tow-ard,' and so on. In all the observers an inclination was noted to make this division a symmetrical one; 'regret' was 'reg-ret,' 'secret,' 'sec-ret.' Words like 'terror,' 'coffee,' 'yellow,' whose syllables, that is, division of the normal sound image, corresponded to symmetrical divisions of the visual word, kept normal sound and meaning longer than those whose visual and auditory divisions did not coincide; thus 'mother' promptly became 'mot-her.' Secondly, the form of one or two letters in a word would often stand out with special prominence from among the others. These letters were more commonly those with more striking forms, such as 'a' and 's;' 'm' was also a salient letter apparently because of its greater area, so to speak; but the letters b, p, d, q, u and n had a curious way of assuming prominence because of their tendency to reverse themselves. That is, p would look like d upside down, b would look like d reversed and so on. This concentration of attention on a single letter was a powerful factor in bringing about the loss of the normal sound association of the word, and also in destroying its familiar look. Thirdly, when a word was unphonetically spelled, it tended, on being fixated, to suggest the sounds connected with the various letters rather than its proper pronunciation. The word 'caught' for example very quickly called up the sound 'cagt.' This was undoubtedly connected with the tendency of individual letters to become the focus of attention in the visual word. One could not say that the more usual sound association was suggested in place of the less usual one, for the letters 'aught' are never pronounced 'agt;' the fact was that the 'g' usurped attention because of its striking form, and produced its own sound association. On the other hand, the word 'indict' suggested 'in dict' both because the c was attended to and because the syllable 'dict' is more commonly pronounced as in 'diction.' 'Tongue' promptly suggested the sound 'ton gue,' because attention fixed on the look of the word naturally centered as much on the silent letters as on those ordinarily sounded.

Again, the appearance of a word steadily fixated would sometimes suggest the sound association of a foreign language.

Occasionally the whole word would act in this way, as when the word 'circle' called up the Italian pronunciation 'chircle.' At other times when the word had 'separated' into parts, a part would suggest the foreign sound; for instance, in the word 'jungle,' the letters 'jung' associated themselves with their German sound.

The loss of meaning association from the word complex seems to us to be intimately connected with the fluctuations and changes in the sound images suggested. The associative connection between the sound of a word and its meaning is much closer than that between the meaning and the mere look of the word. When, as not infrequently happened in the later stages of an experiment, no sound image whatever was present, although the word as seen retained its familiarity, there was never any vestige of meaning present. The look of a word probably cannot suggest its meaning without the simultaneous presence of an auditory-motor image. The fact that spoken language is both earlier learned and oftener used than written language is a sufficient reason for this.

The meaning, then, vanishes when the proper sound image of the word disappears. But why should the latter go? We have seen that its place is usually taken by other sound images suggested by parts of the visual word, either syllables or letters. The reason why these fragments of the word assume prominence is doubtless connected with the law of shifting attention. The attention, concentrated upon the appearance of the word, cannot remain fixed for more than a few seconds upon this as a whole, but shifts from one syllable to another, or is attracted to a particular letter that has some peculiarity of form; and as now one part of the visual word, now another, is attended to, the sound associations also vary. The normal sound association of the whole word is thus lost.

If we ascribe the loss of meaning and of the normal sound image to the shifting of attention from one part of the visual word to another, how are we to explain the further changes that often occur in the later part of an experiment? At one stage, the printed word, with a perfectly familiar aspect, is attended to as a whole, without the slightest suggestion of either sound or meaning. Then the familiarity mark of the combination may be lost, and the word is a group of letters, the letters themselves being really letters, however, that is, being familiar, though without sound suggestion. And finally, the letters themselves become mere oddly shaped marks on paper. Thus for example, 'pocket' with observer S. first suggested a meaning association, which was lost upon the word's separation of itself into poc-ket; then the c looked like a broken 'o' and the sound suggested was 'pooket;' then the letter k assumed prominence and began to look unfamiliar; finally all the letters

except p and o 'looked queer.' The word 'middle,' after suggesting two or three meanings to observer Sea., lost its ordinary meanings through the prominence assumed by 'iddle,' which seemed to the observer to have a vague meaning of its own, as well as a sound; then the word became a mere collection of letters, the d's looking like b's turned backward, and at the end of the three minutes the letters themselves had become 'queer marks.' A fact which interested us about the later stages was that the visual word as a whole could look familiar after it had ceased to suggest either meaning or auditory-motor associations. The same was true of the individual letters. The passage from the stage where the word was a familiar visual object in its entirety to that where it became a mere 'collection of letters' was distinctly later in its occurrence than the loss of definite associations with the word. Similarly, when the letters themselves ceased to be letters and became marks on the paper, it was not because they lost at that moment all suggestion of sound; the sound had usually gone sometime before. It was a loss of familiarity, not of association; and the experiments illustrated very clearly the fact that familiarity, recognition, does not necessarily involve associated ideas.

But why do the shifting associations disappear, and why does the familiarity itself ultimately disappear? If the shifting associations are due to the tendency of attention to fluctuate, the same tendency which is illustrated in rivalry, and is here shown by the wandering from one part of the visual word to another, why does not this process keep up indefinitely? It looks very much as though we had to deal here with something like auto-hypnosis. Prolonged concentration of the attention upon an object which, while it does not remain entirely unchanged, yet can change only within narrow limits and with constant recurrence to the same phases, produces an increasing narrowness of the field of consciousness; the associations drop off entirely, then the 'fringe' of familiarity goes, and finally we approach as nearly to a bare, peripherally excited sense impression of the marks which normally are letters, as we can get in adult experience. Whatever may ultimately turn out to be the explanation of the narrowing of consciousness in hypnosis brought on by attention to a monotonous object, will explain the final loss of associative power and of familiarity in a word long fixated. For attention, pure Being and Not-Being are identical; we attempt to reach perfect concentration of attention upon a single object, and the object dissolves in the process.

In conclusion we may add that analogous phenomena have been observed by many people as occurring when a spoken word is repeated a number of times, so that attention is abnormally concentrated on its sound. Experiments upon this point are to be undertaken in the near future.